From: dwcartwright@transsystems.com
Subject: RE: Lake Park Arch Bridge Report Review
Date: October 4, 2018 at 3:55 PM
To: ckreilly@outlook.com
Cc: Wesley.Weir@wsp.com

Colleen,

Following up on our discussion from earlier, TranSystems would like to provide clarification on the Khan bar reinforcement system as discussed in GRAEF's review of our analysis report. In particular, we do not agree with the assertion that the entire bar area cannot be included for flexural strength due to discontinuities in the outer fins.

The review of our report states that the Khan bars have transverse slits even where bars are not bent up, and we do not believe this to be true. The Khan bars are fabricated as one continuous bar with a diamond-shaped inner core and fins on the outside. In order to create the include shear reinforcing, the fins are cut with a small transverse slit and variable-length longitudinal cuts which then allow the bars to be bent up. The bars are not fabricated with these cuts pre-made, and the center portion of the bar is left continuous to allow for full capacity of the bars (core + fin) in flexure. This is shown in Fig 11 on Page 4 of GRAEF's review.

Furthermore, GRAEF states that only the middle 6" of the bar length is left continuous and uncut. We believe GRAEF has incorrectly interpreted the standard cut diagram (Fig 14 on Page 6 of their report). In this diagram, the center portion of the bars shown is intentionally **not** dimensioned, as this length would be customized based on the configuration of the member being reinforced. The purpose of this diagram is strictly to demonstrate the dimensions for these cuts for different bar sizes and lengths of bent shear bars. This diagram does not specify the uncut flexural length left in the middle of the bar, and the only reason it is drawn so short is likely just to fit all the detail needed on the page. In fact, the bottom diagram showing 18" and 24" cuts specifically has a break line shown in the middle of the bar.

Based on several field photographs of the deck underside, it appears very clear that the full bar is included for most of the length of the transverse deck with while the fins are bent up near the ends. This supports the concept that the Khan system was utilized to provide full bar area in the primary flexure areas and additional shear capacity near the ends. There are no photographs suggesting that the fins are cut transversely near the center of the span. As is the design intent of the Khan system, each bar is fabricated continuously and only cut specifically in areas where bars are being bent up to provide additional shear capacity.

I have attached a very brief markup which calls attention to these points. If you have any questions, please don't hesitate to let myself or Wes know.

Thanks,
Don

From: Colleen Reilly [mailto:ckreilly@outlook.com]
Sent: Friday, September 21, 2018 4:54 PM
To: Wesley.Weir@wsp.com; CL-Don Cartwright <dwcartwright@transystems.com>; margaret@demichele.com; P.Schultz@horizondbm.com; srduback@yahoo.com
Subject: Fwd: Lake Park Arch Bridge Report Review

I have not yet reviewed this, but wanted to get this to you.

Colleen Reilly, PMP
(414) 202-5730
ckreilly@outlook.com

Begin forwarded message:

From: "Stave, Karl" <Karl.Stave@milwaukeecountywi.gov>
Date: September 21, 2018 at 3:38:52 PM CDT
To: Colleen Reilly <ckreilly@outlook.com>
Subject: FW: Lake Park Arch Bridge Report Review

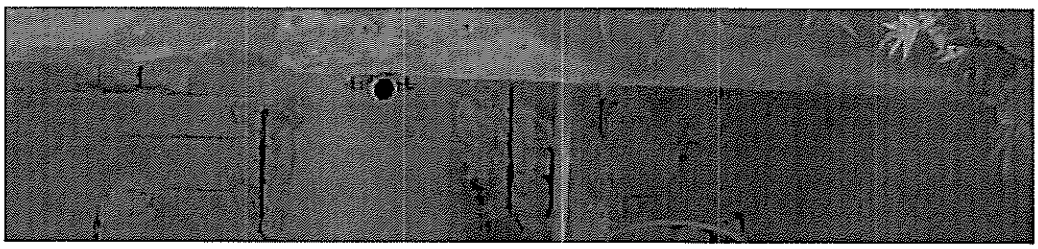
Colleen,

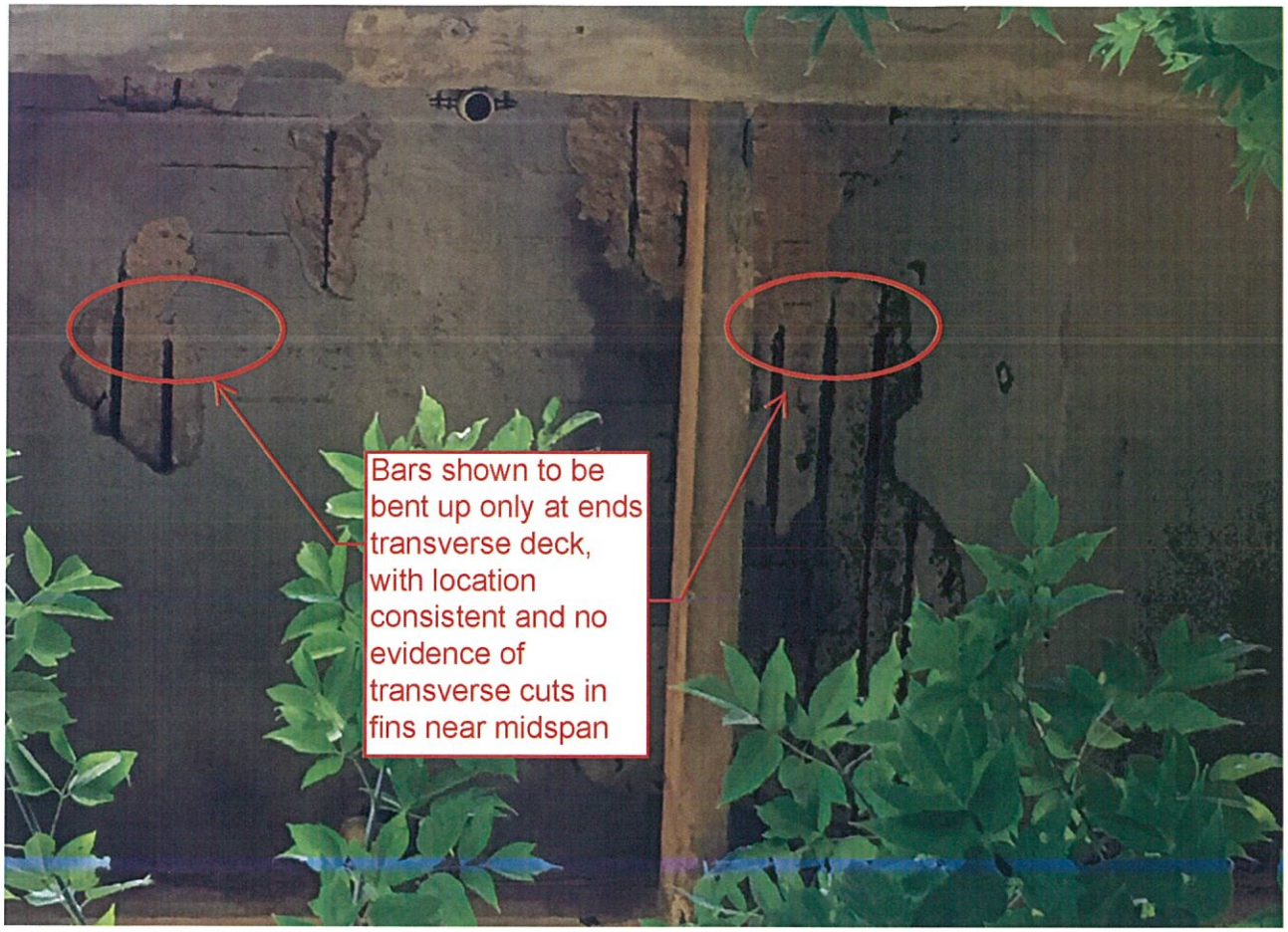
See attached review. I haven't reviewed it yet but wanted to get it to you before the weekend.

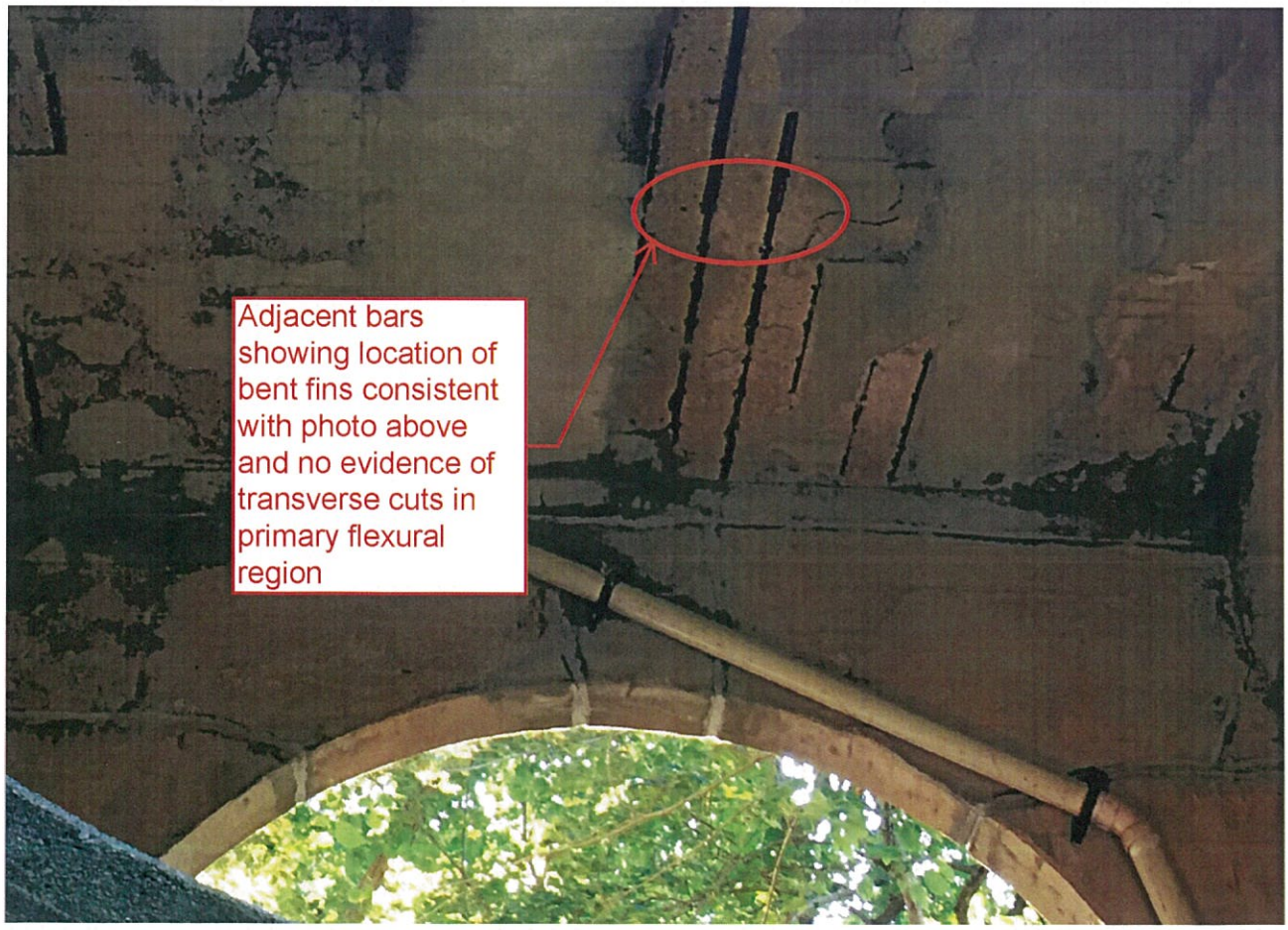
Thanks,

Karl Stave, P.E.
Architecture, Engineering & Environmental Services
DAS - Facilities Management Division
Milwaukee County
633 W. Wisconsin Ave.
Suite 1000
Milwaukee, WI 53203
(414) 278-4863

Lake Park Arch Bridge
Load Calcu...mments.pdf




Bars shown to be bent up only at ends transverse deck, with location consistent and no evidence of transverse cuts in fins near midspan


Adjacent bars showing location of bent fins consistent with photo above and no evidence of transverse cuts in primary flexural region

square bar at predefined lengths. These cuts allow the fins to be bent up to provide shear reinforcement for the concrete element. The images below from Kahn's 1904 Handbook illustrate this configuration.

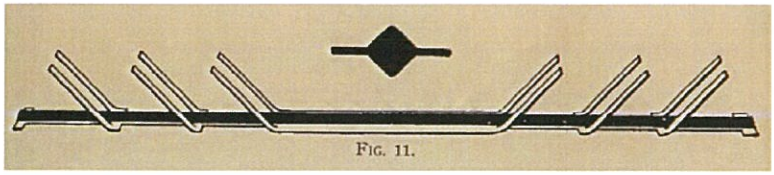
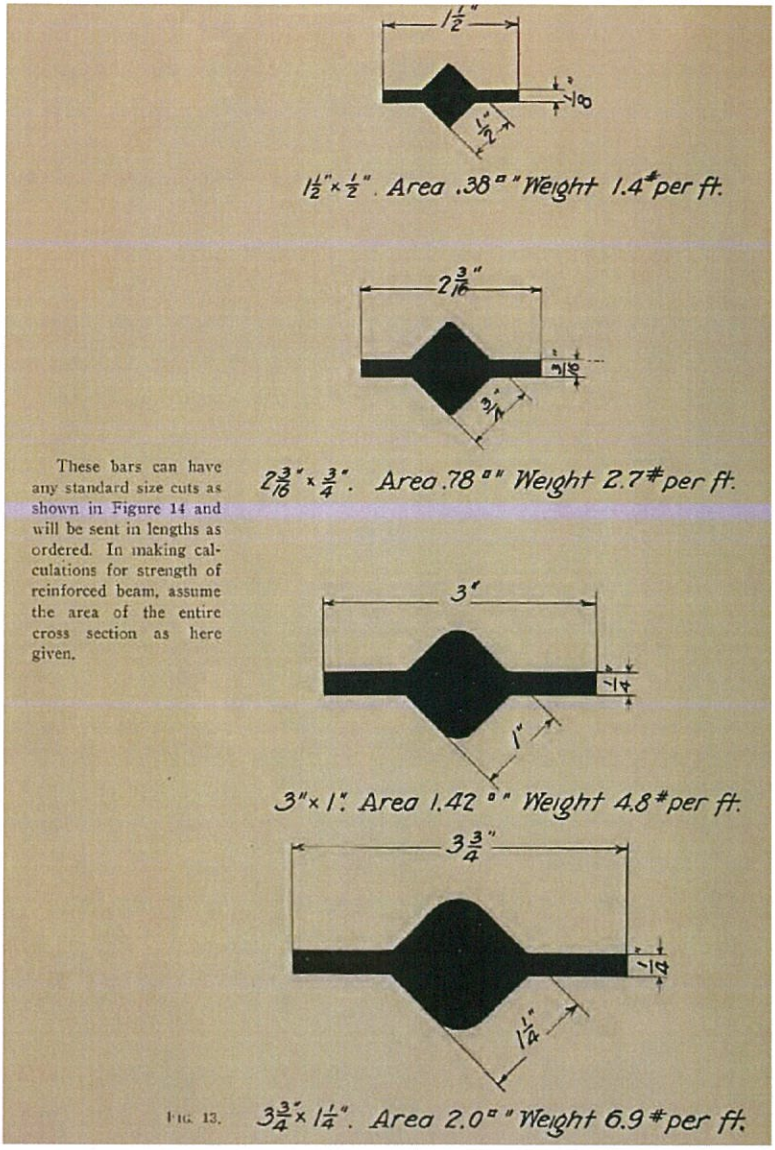
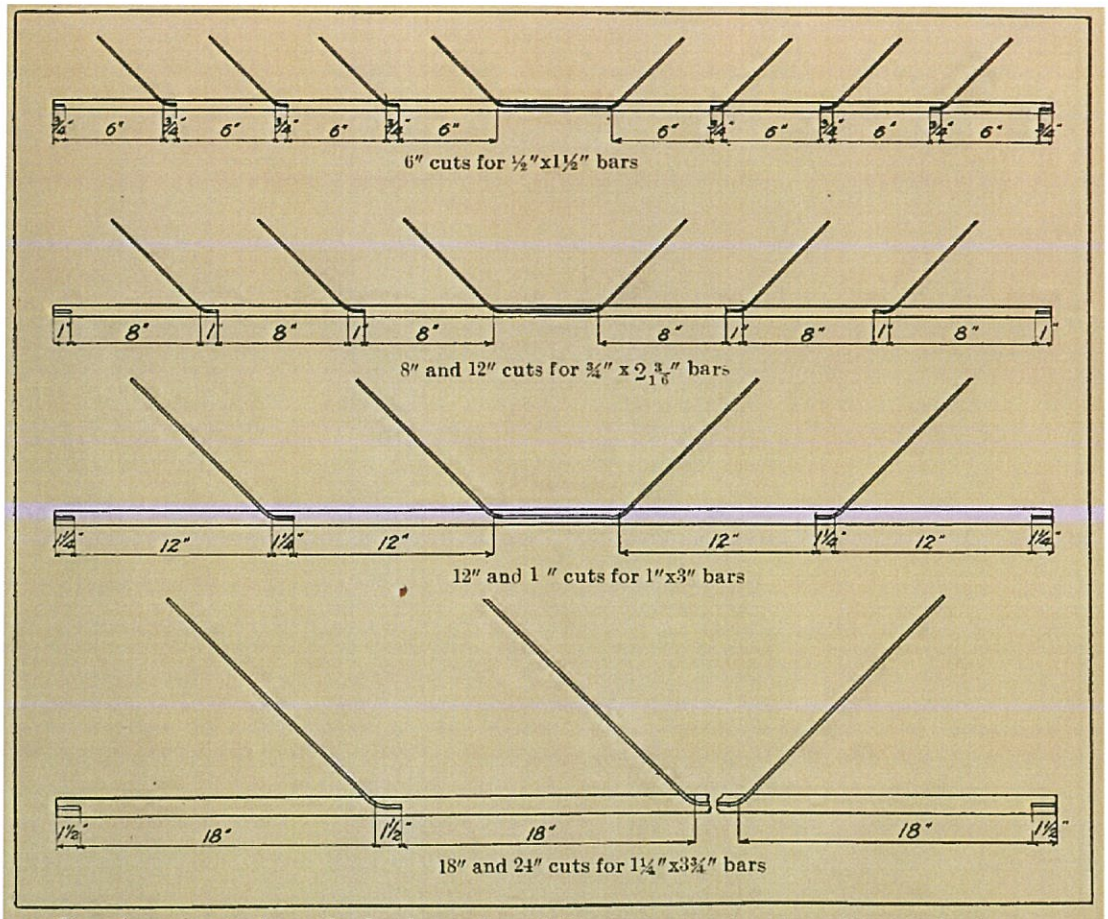


FIG. 11.



These bars can have any standard size cuts as shown in Figure 14 and will be sent in lengths as ordered. In making calculations for strength of reinforced beam, assume the area of the entire cross section as here given.

FIG. 13.

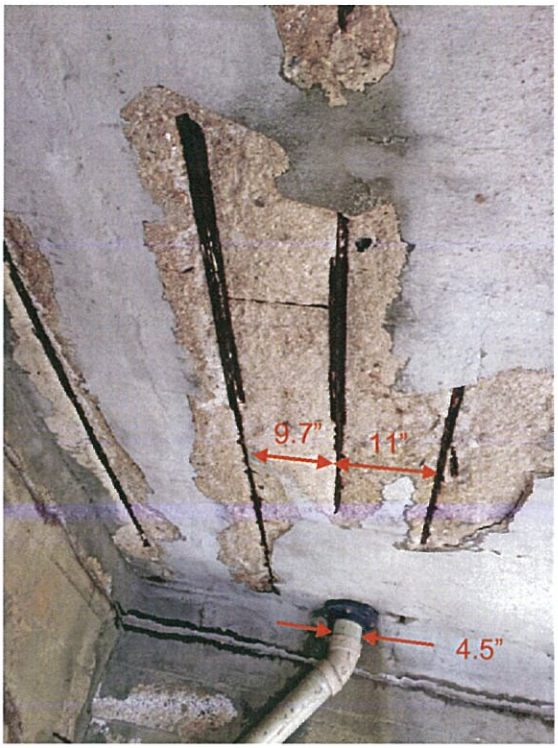


Bars kept in stock ready for immediate delivery, in any lengths with standard cuts.

FIG. 14.

TranSystem determines the load carrying capacities of the deck, spandrel beam, and arch rib using an ASD approach. Given the limited as-built information available for this bridge, several assumptions must be made with respect to the Kahn bars. Review of TranSystem's load capacity calculations versus field observations and GRAEF's 2005 and 2015 analyses suggests an approach which in some cases is unconservative.

Deck – according to the original design drawings, ½" x 1 ½" Kahn bar reinforcing steel was to be placed transversely at 18" centers within a 6" thick deck. Using information available from a 1910 textbook, a rebar area of 0.41 in^2 spaced at 18" and a 6" thick deck was used to determine GRAEF's 2005 deck load rating



- Original design drawing deck cross sections and field observations of underside spalls (see image above) suggest the Kahn bar fins are bent up for most of the deck width. This will reduce the reinforcement areas assumed by both GRAEF and TranSystem.
- The 1904 Kahn bar literature suggests the full bar areas (square bar area plus bar fins) can be used to determine the strengths of reinforced beams. However, we do not believe this is an appopriate approach for two reasons. First, the bent up fins provide no bending strength. Second, even when bars are not bent up, the discontinuity of the steel where fins are transversely slit makes use of the fins questionable. From the 1904 Kahn bar literature Figure 14 and deck underside photograph earlier, only the middle 6" of the bar length has continuous uncut fin steel, and only this length should be considered effective as having the full square bar plus fin area. Regions beyond the middle 6" should consider the square bar area only.
- When using ASD to determine the capacity of reinforced concrete flexure members, AASHTO Standard Specifications 8.15.3 state that straight-line theory of stress and strain in flexure be used. TranSystems calculations appear to use working stresses in a Whitney Block approach to compute